

FORM PTO-1390 (REV 11-2000)		U S DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTORNEYS DOCKET NUMBER 742111-133
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371			U S APPLICATION NO (If known, see 37 CFR 1.5) 10/069978
INTERNATIONAL APPLICATION NO. PCT/DK00/00504	INTERNATIONAL FILING DATE 13 SEPTEMBER 2000	PRIORITY DATE CLAIMED 14 SEPTEMBER 1999	
TITLE OF INVENTION DIAPHRAGM TRANSDUCER			
APPLICANT(S) FOR DO/EO/US Nils Peter REENBERG			
<p>Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:</p> <ol style="list-style-type: none"> <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371. <input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371. <input checked="" type="checkbox"/> This is an express request to promptly begin national examination procedures (35 U.S.C. 371(f)). <input type="checkbox"/> The US has been elected by the expiration of 19 months from the priority date (PCT Article 31). <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2)) <ol style="list-style-type: none"> <input type="checkbox"/> is attached hereto (required only if not communicated by the International Bureau). <input checked="" type="checkbox"/> has been communicated by the International Bureau. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US). <input type="checkbox"/> An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)). <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)). <ol style="list-style-type: none"> <input type="checkbox"/> are attached hereto (required only if not communicated by the International Bureau). <input checked="" type="checkbox"/> have been communicated by the International Bureau. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired. <input type="checkbox"/> have not been made and will not be made. <input type="checkbox"/> An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)). <input checked="" type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)). <input type="checkbox"/> An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)). <p>Items 11 to 20 below concern document(s) or information included:</p> <ol style="list-style-type: none"> <input type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98. <input checked="" type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included. <input checked="" type="checkbox"/> A FIRST preliminary amendment. <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment. <input type="checkbox"/> A substitute specification. <input type="checkbox"/> A change of power of attorney and/or address letter. <input type="checkbox"/> A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825. <input type="checkbox"/> A second copy of the published international application under 35 U.S.C. 154(d)(4). <input type="checkbox"/> A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4). <input checked="" type="checkbox"/> Other items or information: Application Data Sheet, 6 Sheets of Drawings (Figs. 1-5) 			

U.S. APPLICATION NO (If known, see 37 C.F.R. 1.50) 10/069978		INTERNATIONAL APPLICATION NO PCT/DK00/00504		ATTORNEYS DOCKET NUMBER 742111-133	
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21. <input checked="" type="checkbox"/> The following fees are submitted: BASIC NATIONAL FEE (37 CFR 1.492(a)(1) – (5)): Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO..... \$1040.00 International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO..... \$890.00 International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(3)) paid to USPTO \$740.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4)..... \$710.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) \$100.00 ENTER APPROPRIATE BASIC FEE AMOUNT =				CALCULATIONS		PTO USE ONLY	
				\$890.00			
Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				\$0			
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE				
Total claims	10-20 =	0	X \$18.00	\$0			
Independent claims	1-3 =	0	X \$84.00	\$0			
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ \$280.00	\$0			
TOTAL OF ABOVE CALCULATIONS =				\$890.00			
<input checked="" type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2.				\$445.00			
SUBTOTAL =				\$445.00			
Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				\$0			
TOTAL NATIONAL FEE =				\$445.00			
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property +				\$ 40.00			
TOTAL FEES ENCLOSED =				\$485.00			
				Amount to be refunded:	\$		
				charged:	\$		

a. ☒ A check in the amount of \$485.00 to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. 19-2380 in the amount of \$_____ to cover the above fees. A duplicate copy of this sheet is enclosed.

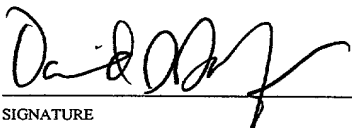
c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 19-2380(742111-133). A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO

NIXON PEABODY LLP
 8180 Greensboro Drive
 Suite 800
 McLean, Virginia 22102

March 14, 2002


 SIGNATURE

David S. Safran
 NAME

27,997
 REGISTRATION NUMBER

Docket No. 742111-133

IN THE UNITED STATES DESIGNATED/ELECTED OFFICE

IN RE INTERNATIONAL APPLICATION NO. PCT/DK00/00504

INTERNATIONAL FILING DATE: September 13, 2000

APPLICANT: Nils Peter REENBERG

TITLE: DIAPHRAGM TRANSDUCER

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Preliminary to calculation of the filing fee and examination of this application, please amend the above-captioned application as follows:

In the Claims:

Cancel all of claims 1-10 and add the following new claims in their place:

- 11. Diaphragm transducer comprising
- a planar diaphragm,
 - magnets arranged to provide magnetic field strength through said planar diaphragm,
 - said magnets being in magnetic interaction with a magnetically conducting material,
 - said magnets being arranged on one side of said diaphragm,
 - said diaphragm having a plurality of conductors on its planar surface for inducing electromagnetic force acting on said conductors when current flows through said conductors,
- wherein
- said magnets are in magnetic interaction with a magnetically conducting material to conduct magnetic field strength from said magnets to said diaphragm,
 - said magnetically conducting material is not a permanent magnet, and
 - said conductors on said diaphragm are arranged in a pattern in relation to said magnetic field strength through said diaphragm, said relation being such that said

electromagnetic force acting on said conductors is directed substantially normal to said surface of said planar diaphragm.

2. Diaphragm transducer according to claim 11, wherein said conductors are arranged in a pattern with varying mutual distances and directions.

3. Diaphragm transducer according to claim 11, wherein that said magnetic field through said diaphragm is approximately constant.

4. Diaphragm transducer according claim 11, wherein said magnetically conducting material is configured as plates, between which permanent magnets are located, where one edge of each of said plates constitutes a magnetic pole for providing field strength through said diaphragm.

5. Diaphragm transducer according to claim 14, wherein the number of poles are at least three with two outer poles and at least one inner pole.

6. Diaphragm transducer according to claim 15, wherein said number of inner poles located between the outer poles is at least two, where said inner poles are arranged in pairs of poles with a distance between the two plates constituting said pair.

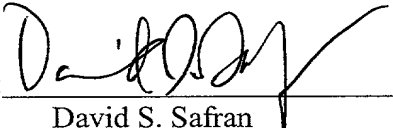
7. Diaphragm transducer according to claim 16, wherein said distance between said two plates constituting a pair of poles, is between 0.1 and 3 mm, preferably between 0.3 and 1.5 mm and preferably between 0.4 and 0.6 mm.

8. Diaphragm transducer according to claim 11, wherein said magnetically conducting material is soft iron

9. Diaphragm transducer according to claim 11, wherein said diaphragm comprises a magnetically conducting layer.

10. Diaphragm transducer according to claim 19, wherein said magnetically conducting layer comprises at least one from the group consisting of a coating with soft iron and a coating with Permalloy.--

Respectfully submitted,

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6/p1b

Diaphragm transducer

The present invention relates to a diaphragm transducer as described in the preamble of claim 1.

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As loudspeakers, mainly two types are common. The one type comprises an annular coil disposed in a transverse magnetic field, where the coil is connected to a diaphragm, usually conical in shape. Current flowing through the coil results in a force moving the diaphragm. The second type comprises a planar diaphragm, where conductors are positioned on the planar surface. A magnetic assembly behind or at the sides of the membrane result in displacement of the membrane, when current flows through the conductors.

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It is well known, that the second type of loudspeaker is more expensive to manufacture as compared to the first type and the efficiency is lower. However, the quality of the emitted sound is much better in the second type, as it does not suffer from distortions of the membrane to the same extent as the first type.

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An example of a loudspeaker with a planar diaphragm transducer is described in US patent no. 5,195,143. With reference to a drawing in that reference, which is reproduced in FIG. 1a, a woofer diaphragm 100 is located in front of an assembly of magnets 102 where magnetic field lines 104 propagate between corresponding north poles, N, and south poles, S. In order to produce proper sound, the diaphragm 100 has to move transversely to the plane of the diaphragm, which requires magnetic field lines 104 which are parallel to the plane and normal to the conductors on the diaphragm. However, as can be seen from FIG. 1a, a large portion of indicated field lines 104, are normal and not parallel to the diaphragm 100, resulting in low efficiency of the loudspeaker and distortion at higher currents.

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Meanwhile, further study of the problem has shown, that the magnetic field lines 104', actually, do not propagate as shown on FIG. 1a, but rather propagate as shown in FIG. 1b, which explain the low efficiency of this type of loudspeaker, as the majority of

magnetic field line propagate transversely to the diaphragm plane, which is inappropriate.

As shown in FIG. 2a, according to prior art, it is possible to arrange magnets 102 such that the magnetic field lines are more parallel to the diaphragm 100, for example by placing the diaphragm 100 between a north and a south poles, where the diaphragm is normal to the surface of the poles. This arrangement, however, is only suitable for small diaphragms because of the required narrow space between the poles. Therefore, it is only used for loudspeakers in the high frequency regime and not for woofers. It is generally assumed for this arrangement, as shown in FIG. 2a, that the field lines 104 propagate from the left north pole of the arrangement to the right south pole.

However, study of this arrangement has shown that the field lines propagate as indicated in FIG. 2b, which illustrates the insufficiency of this arrangement. The field is very weak at the centre of the arrangement, and placing the diaphragm off-centre as shown in FIG. 2b results in field lines not parallel with the diaphragm.

A number of attempts have been undertaken to improve this type of loudspeakers, where the main effort has been put into the shaping of the magnetic field in the region in which the diaphragm is moved. In US patent no. 4 491 698, a diaphragm transducer is disclosed having a planar diaphragm with vanes extending perpendicular from the diaphragm and into a magnetic arrangement behind the diaphragm. However, no suitable solution has yet been found, notwithstanding the fact that this principle for loudspeakers has been existing for a long time.

In US patent no. 4 354 066, a non-planar, rigid-diaphragm transducer is disclosed with a coil for interaction with a magnetic field, where the coil support is outside the diaphragm. In US patent 5 297 214 a loudspeaker is disclosed with a planar diaphragm having thin conductors thereon. The magnetic field is provided by an arrangement of permanent magnets on one side of the diaphragm.

It is an object of the invention to provide a diaphragm transducer of the above mentioned second type with a higher efficiency than known systems. It is a further object of the invention to provide a transducer with higher efficiency which is also cheap and easy to manufacture.

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This object is achieved with a diaphragm transducer as mentioned by way of introduction which is characterised as described in the characterising part of claim 1.

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Using ferromagnetic material as soft iron in connection with loudspeakers of the second type is a very simple solution because the shaping of a magnetic field is much easier with ferromagnetic material than with magnets. Magnetic field lines are changed with respect to their direction when traversing soft iron because the magnetic reluctance in soft iron is much lower than in air.

In the following, soft iron will be used as a synonym for a magnetically conducting material. However, the magnetically conducting material can also be other material than soft iron with analogue properties and not being a permanent magnet. Possible other materials are iron-silicon, Permalloy, or iron-oxides.

According to further study of the invention, it has turned out, that it is possible to achieve an approximately constant magnetic field in the planar region where the diaphragm is located.

Shaping of the magnetic field can be achieved by applying plates of soft iron between which permanent magnets are located. One edge of each of said plates constitutes a magnetic pole in said configuration. For example, an arrangement can comprise three poles, two outer poles of equal polarity and one inner pole of opposite polarity.

The intensity of the magnetic field depends on the field strength of the magnets that are placed between the soft iron plates. But as the conduction of the magnetic field lines from the magnets, through the soft iron plates, and to the diaphragm is efficient, the invention opens the possibility to achieve high field strengths in the planar region even with relatively weak and cheap magnets. That has as a consequence, that this type of loudspeaker can be produced much cheaper than hitherto and for a price that can compete with the price for loudspeakers with annular coils. Therefore, a large number of people, that could not afford this type of loudspeaker before, will be able to enjoy a clearer and more differentiated sound of music in their homes.

Surprisingly, it has turned out, as intense studies have shown, that it is a great advantage, if the inner poles located between the outer poles are arranged in pairs with a distance between the two plates constituting said pair. As compared with single inner poles, the magnetic field in the plane in front of the double poles is much more constant in strength and direction.

Because of the magnetic field in the planar region can be shaped to be approximately constant, the conductors on the diaphragm can easily be oriented and connected such that, when current flows through those conductors, the electromagnetic forces acting on the conductors in the planar region are approximately in the same direction normal to the plane of the diaphragm. This is the ideal case, but as the introductory discussion showed, that this has by far not been achieved in systems according to prior art.

Even higher field strengths can be achieved when the field is allowed to vary with a small amount. Small field strength variations can be adjusted for by placing the conductors on the diaphragm with varying mutual distances and directions.

To achieve a better performance of a transducer according to the invention, the diaphragm in a transducer may have a ferromagnetic magnetisable layer. The layer can be part of the diaphragm material or be applied as a coating.

According to prior art, ferromagnetic magnetisable material as ferric oxide, Permalloy or soft iron has been used on annular coils in loudspeakers of the first type, for example in UK patent application GB 2,137,047 or in European patent application EP 587 910. The effect in these papers was damping and increasing the efficiency. For the above mentioned second type of loudspeaker, it has not been recognised that an improvement can be achieved.

However, as with the soft iron plates, a magnetically conducting layer in or on the diaphragm, for example a coating with soft iron, conducts the field lines along the diaphragm. The result is an increased number of field lines parallel with the diaphragm enhancing the efficiency of the transducer.

A soft iron coating on the diaphragm should be very thin and does, therefore, not conflict with the aim that the transducer diaphragm should have a very low mass. Once accelerated because of the current through the conductor in the magnetic field, a diaphragm with a higher mass will be harder to stop than a diaphragm with a lower mass. This might result in an overshooting of the diaphragm at peak currents with a result of sound distortions. A damping of the diaphragm may be achieved with the ferromagnetic material on the diaphragm. As the diaphragm moves in the magnetic field, the magnetic field changes causing a different magnetisation of the coating. The change in the magnetisation has the effect of damping the motion of the membrane, especially at large excursions. The damping ability is dependant on the magnetic hysteresis of the ferromagnetic material. Soft iron has a very low hysteresis, while Permalloy has a larger hysteresis. Which material is the best depends on the actual construction of the diaphragm transducer, especially, whether it is designed to work at higher or lower frequencies. As a rule of thumb, it should be mentioned here, however, that the lower the working frequency of the transducer, the higher a damping is needed.

The invention will be described further with reference to the drawing where FIG. 1 illustrates the principle of a planar transducer according to prior art, FIG. 2 illustrates the principle of a different transducer according to prior art, FIG. 3 illustrates the principle of diaphragm transducer according to the invention, FIG. 4 is a schematic view diaphragm transducer according to the invention.

FIG. 3 shows a diaphragm transducer according to the invention. Two magnets 102 with corresponding north poles, N, and south poles, S, are arranged in magnetic interaction with plates of soft iron 106. Each magnet 102 can consist itself of a number of smaller magnets acting in combination. The shown arrangement comprises three magnetic poles, two outer poles 106 and 106' of equal polarity, N, and an inner pole 107 of opposite polarity, S.

The construction as shown in FIG. 3 has a number of advantages. First, magnets are arranged behind the diaphragm and not beside the diaphragm. Therefore be built in a

more narrow and more aesthetic design than hitherto. The necessary mass of the magnets 102 is stored behind the diaphragm 100. Second, to achieve a high field strength, relatively large magnets 102 or many magnets in combination can be used. thus, it is possible to achieve high field strengths even with magnets 102 that are low in production cost, which results in a low production cost of the transducer itself. Third, shaping of the field in the planar region of the diaphragm is relatively easy. To shape the field at the diaphragm, only the plates 106, 106', 107 have to be shaped, which is far more easy than shaping eventually brittle magnets 102. Fourth, assembly of the magnetic arrangement is easy and quick once the plates 106, 106', 107 are shaped.

FIG 4a. shows the transducer according to the invention in an exploded view. The diaphragm 100 is equipped with conductors 108 that are mutually connected, for example in a spiral arrangement as indicated on the figure. Current is applied to the conductors by appropriate connectors 110. The diaphragm is supported by a frame 114 of damping material, for example foam polymer. The structural support frame 116 of a rigid material secures a proper positioning of the magnets 102 and soft iron plates 106, 106', 107 with respect to the diaphragm 100.

A drawing of the assembly is shown in FIG. 4b through 4e, where FIG. 4b is a front view, FIG. 4c is a side view, FIG. 4d is a back view, and FIG. 4e is a view along the cut A-A as indicated on FIG. 4b. It can be seen, that only the longitudinal parallel conductors 108 are within the planar region 118 where the magnetic field has a high strength.

An alternative construction for a transducer according to the invention is achieved by fixing the diaphragm only at its end 112, 112', whereby the polymer support 114 can be omitted.

As described before, and illustrated in FIG. 5a, it has turned out that it is a great advantage, if the inner pole located between the outer poles is arranged in pairs 107, 107' with a distance 103 between the two plates 107, 107' constituting that pair. As compared with single inner poles, the magnetic field in the plane in front of the double

poles 107, 107' is much more constant in strength and direction, which has been confirmed by experiment, but has not yet been completely understood.

5 The magnetic field 104 lines are in reality much more parallel with the diaphragm 100 than those drawn on figure 5a, as the field lines on the figure only serve for illustration.

In analogy to the arrangement in FIG. 5a, another arrangement with a plurality of pairs of poles is shown in FIG. 5b.

10 The diaphragm is equipped with a number of conductors 108. In front of the inner poles 107, 107', the conductor 108, 108' have approximately the same distance 103 as the plates 107, 107'. For a high frequency loudspeaker, this distance is between 0.1 and 3 mm, preferably between 0.3 and 1.5 mm and mostly preferred between 0.4 and
15 0.6 mm.

CLAIMS

1. Diaphragm transducer comprising

- a planar diaphragm (100),

5 - magnets (102) arranged to provide magnetic field (104) strength through said in-a planar region diaphragm (100),

- said magnets (102) being in magnetic interaction with a magnetically conducting material (106, 106', 107, 107'),

- said magnets (102) being arranged on one side of said diaphragm (100).

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~~- said magnets are arranged behind said planar diaphragm in magnetic interaction with a magnetically conducting material, where the magnetically conducting material is not a permanent magnet, to conduct magnetic field from said magnets to said planar re-~~

15 ~~gion, - said diaphragm (100) having a plurality of conductors (108) on its planar surface for inducing electromagnetic force acting on said conductors (108) when current flows through said conductors (108).~~

characterised in that

- that said magnets (102) are in magnetic interaction with a magnetically conducting material (106, 106', 107, 107') to conduct magnetic field (104) strength from said magnets (102) to said diaphragm (100).

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- that said magnetically conducting material (106, 106', 107, 107') is not a permanent magnet, and ~~said planar diaphragm located in said planar region and parallel with said planar region, said diaphragm having a plurality of conductors on its planar surface for inducing electromagnetic forces acting on theses conductors in said planar region~~

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~~- that -~~

said conductors (108) on said diaphragm (100) are arranged in a pattern in relation to said magnetc field (104) strength through said diaphragm (100), said relation being such that said electromagnetic force acting on said conductors (108) is directed sub-

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stantially normal to said surface of said planar diaphragm (100).

2. Diaphragm transducer according to claim 1, characterised in that said conductors (108) are arranged in a pattern with varying mutual distances and directions.

3. Diaphragm transducer according to claim 1 or 2, characterised in that said magnetic field (104) in said planar region through said diaphragm (100) is approximately constant.

4. Diaphragm transducer according to any one of the claims 1 - 3, characterised in that said magnetically conducting material (106, 106', 107, 107') is configured as plates, between which permanent magnets (102) are located, where one edge of each of said plates constitutes a magnetic pole for providing field strength through said diaphragm (100).

~~2. Diaphragm transducer according to claim 1, characterised in that said magnetically conducting material is soft iron~~

~~3. Diaphragm transducer according to claim 1 or 2, characterised in that said magnetic field in said planar region is approximately constant.~~

~~4. Diaphragm transducer according to claim 1 - 3, characterised in that said magnetically conducting material is configured as plates, between which permanent magnets are located, where one edge of each of said plates constitutes a magnetic pole in said configuration.~~

5. Diaphragm transducer according to claim 4, characterised in that the number of poles are at least three with two outer poles (106, 106') and at least one inner pole (107).

6. Diaphragm transducer according to claim 5, characterised in that said number of inner poles located between the outer poles (106, 106') is at least two, where said inner poles (107, 107') are arranged in pairs of poles with a distance (103) between the two plates (107, 107') constituting said pair.

7. Diaphragm transducer according to claim 6, characterised in that said distance (103) between ~~said the~~ two plates (107, 107') constituting a pair of poles, is between 0.1 and 3 mm, preferably between 0.3 and 1.5 mm and preferably between 0.4 and 0.6 mm.

8. Diaphragm transducer according to any one of the claims 1- 7, characterised in that said magnetically conducting material (106, 106', 107, 107') is soft iron

~~8. Diaphragm transducer according to claim 1 - 7, characterised in that said conductors are oriented and connected such that, when current flows through said conductors, said electromagnetic forces acting on said conductors in said planar region are approximately in the same direction.~~

9. Diaphragm transducer according to any one of the - claims 1- - 8, characterised in that said diaphragm (100) comprises a magnetically conducting layer.

10. Diaphragm transducer according to claim 9, characterised in that said magnetically conducting layer (106, 106', 107, 107') comprises at least one from the group consisting of a coating with soft iron and a coating with Permalloy.

ABSTRACT

Diaphragm transducer

- 5 A new type of diaphragm transducer comprising magnets to provide magnetic field strength in a planar region and a planar diaphragm located in the said planar region. The diaphragm has a plurality of conductors on its planar surface for inducing electromagnetic forces acting on these conductors in said planar region when current flows through said conductors. The magnets are arranged in magnetic interaction with
- 10 a magnetically conducting material, preferably soft iron, to conduct magnetic field from said magnets to said planar region.

(FIG. 5a)

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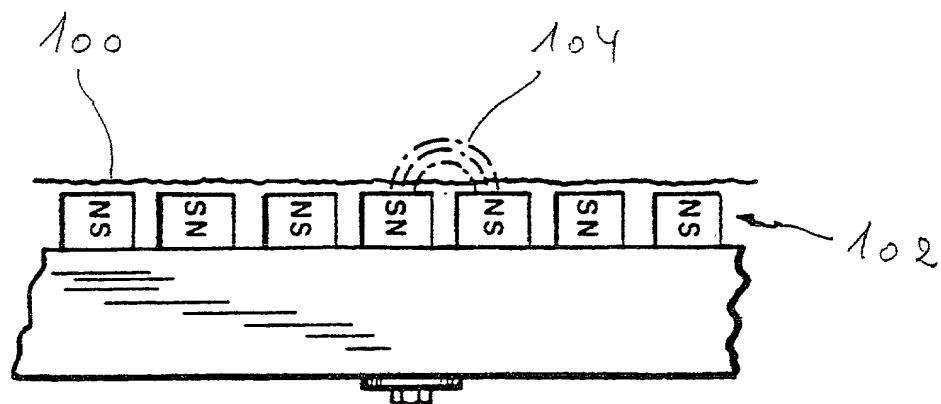
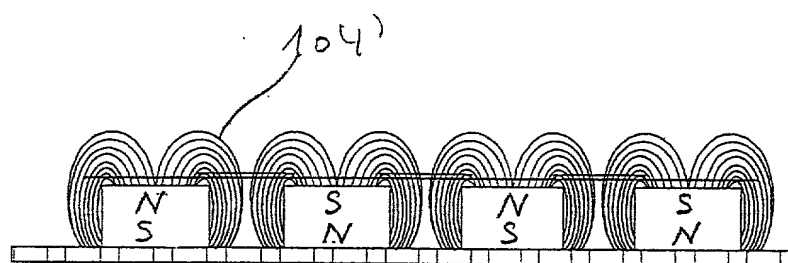


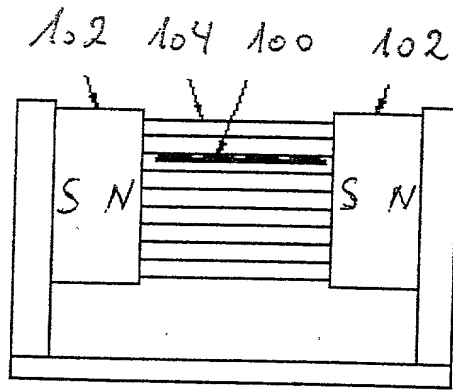
FIG. 1a prior art



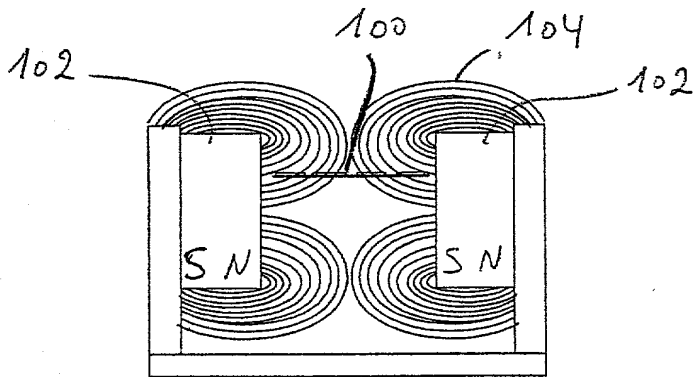
prior art

FIG. 1b

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Prior art.
FIG. 2a



Prior art
FIG. 2b

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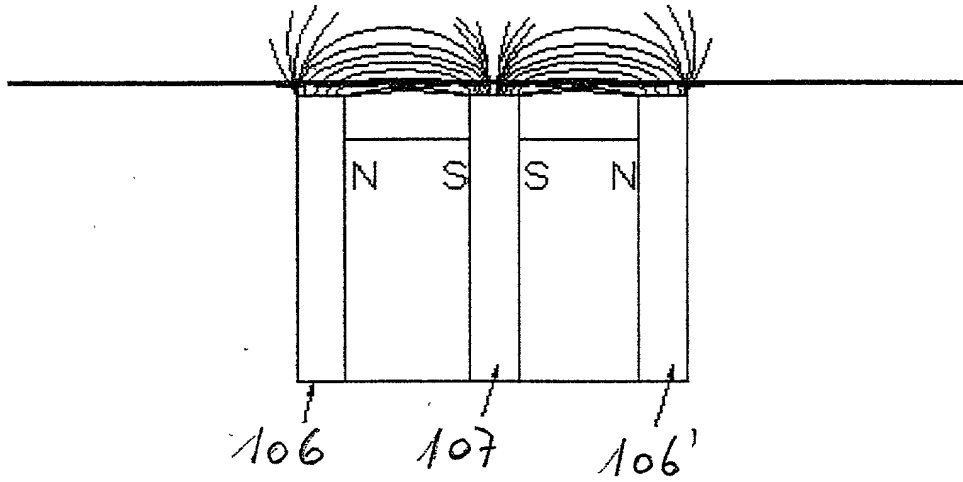


FIG. 3

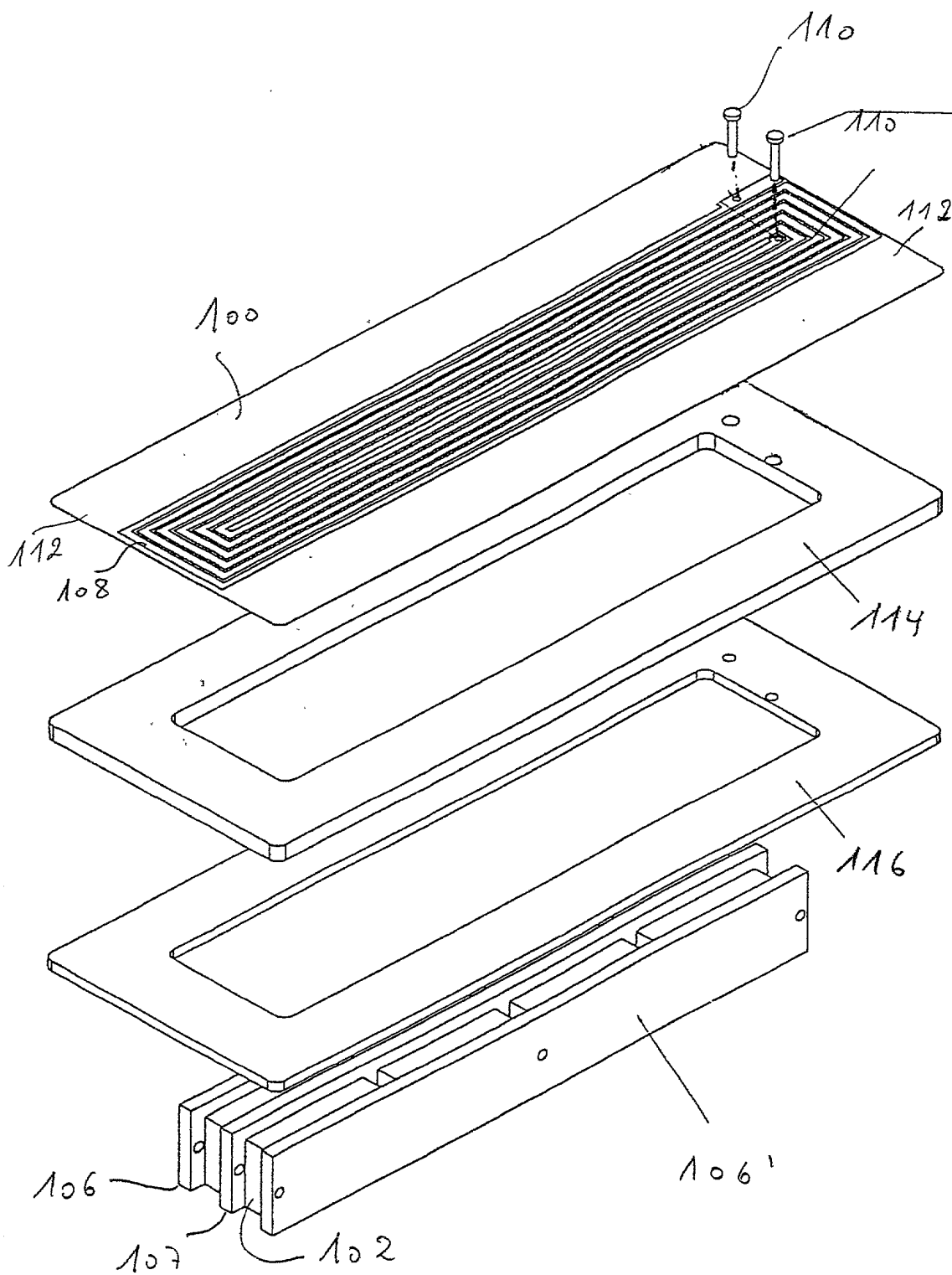
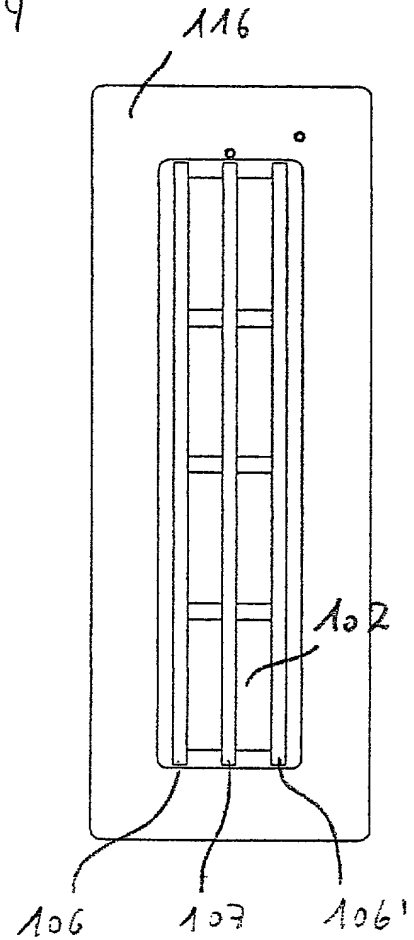
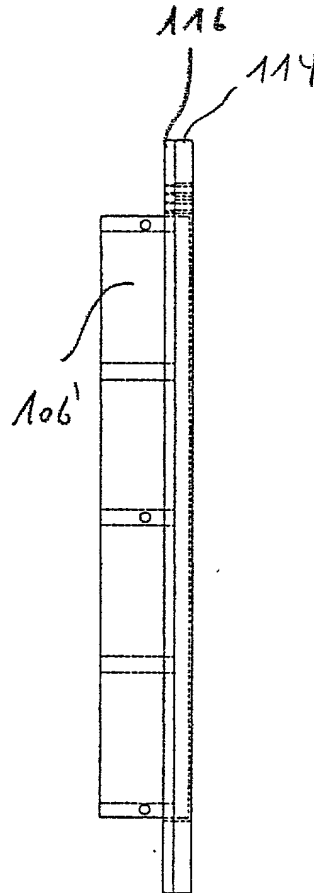
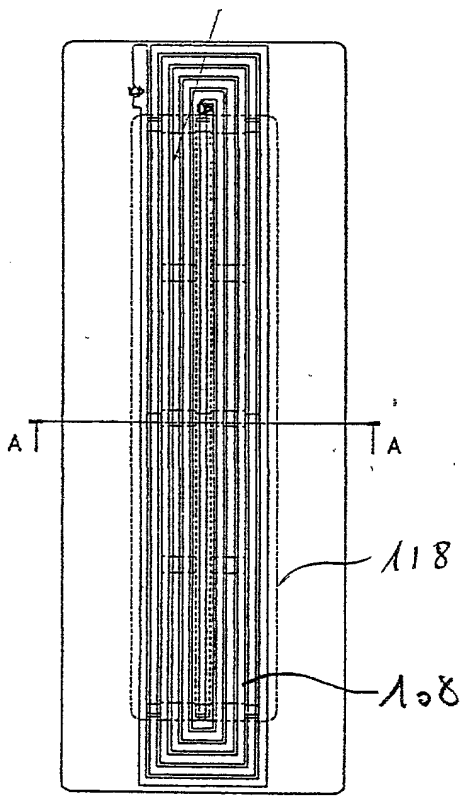
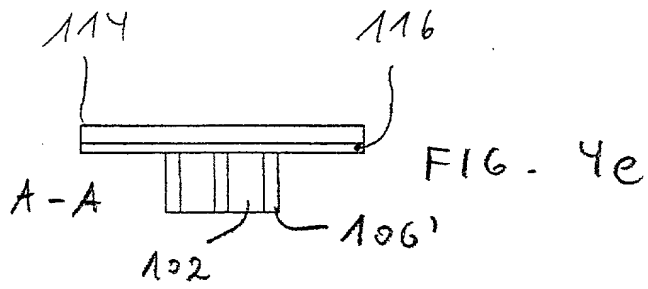


FIG. 4a



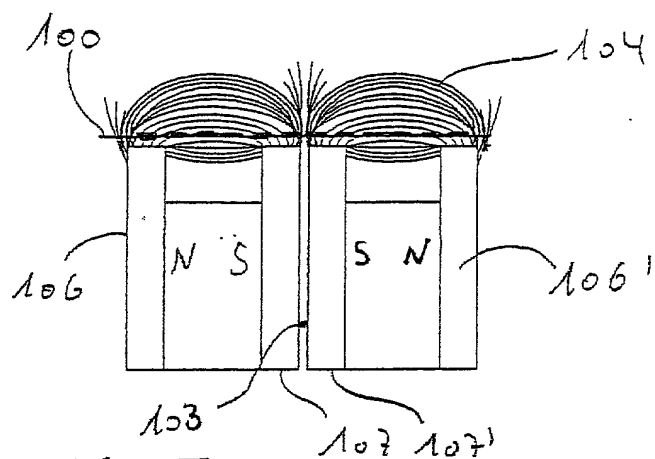


FIG. 5a

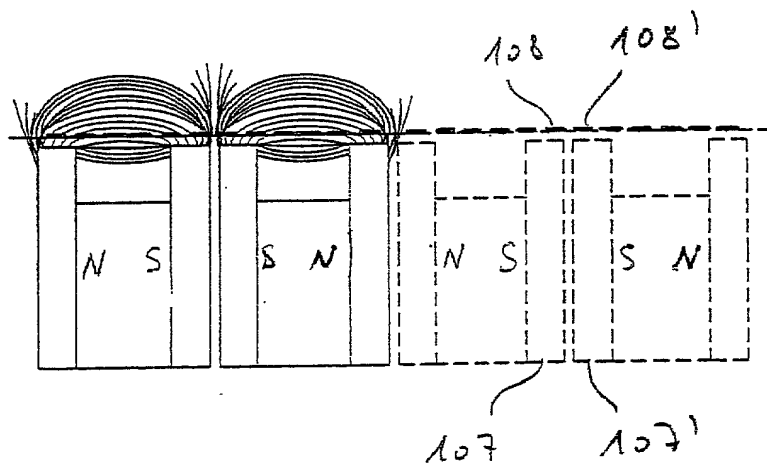


FIG. 5b

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PTO/SB/01 (12-97)

Approved for use through 9/30/00. OMB 0651-0032

Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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**DECLARATION FOR UTILITY
OR DESIGN PATENT
APPLICATION
(37 CFR 1.63)**

☒ Declaration Submitted With Initial Filing OR ☐ Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)

Attorney Docket Number

First Named Inventor

COMPLETE IF KNOWN

Application Number

Filing Date

Group Art Unit

Examiner Name

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Diaphragm transducer

(Title of the Invention)

the specification of which

☐ is attached hereto
OR

☐ was filed on (MM/DD/YYYY) _____ As United States Application Number or PCT International Application Number PCT/DK00/00504 And was amended on (MM/DD/YYYY) _____ (If applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached	
				YES	No
PA 1999 01294	Denmark	Sept. 14, 1999	<input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YYYY)	<input type="checkbox"/> Additional provisional application Numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto

[Page 1 of 2]

Burden Hour Statement. This form is estimated to take 0.4 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissions for Patents, Washington, DC 20231.

Please type a plus sign (+) inside this box → [+]

PTO/SB/01 (12-97)

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DECLARATION - Utility or Design Patent Application

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s), or 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application or PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number (if applicable)

[] Additional U.S. or PCT international application numbers are listed on a supplemental priority date sheet PTO/SB/02B attached hereto

As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith: [X] Customer Number 22204
OR

[X] Registered practitioner(s) name/registration number listed below.

Name	Registration Number	Name	Registration Number
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Charles M. Leedom, Jr	26,477	Joseph S. Presta	35,329
Gerald J. Ferguson, Jr.	23,016	Robert M. Schulman	31,196
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Thomas W. Cole	28,290	Daniel S. Song	43,143
Donald R. Studebaker	32,815	Marc S. Kaufman	35,212
Jeffrey L. Costellia	35,483	William J. Healey	36,160
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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name of Sole or First Inventor:

[] A petition has been filed for this unsigned inventor.

Given Name (first and middle [if any])

Family Name or Surname

Nils Peter

Reenberg

Inventor's Signature:

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[] Additional inventors are being named on the _____ Supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto.